Supply Air Flow and Supply State from Room Loads

Supply air mass and volume flow for a room from its sensible and latent loads, room condition and supply temperature, with the supply humidity and SHR.

Method: Moist-air energy and moisture balances (ASHRAE Handbook—Fundamentals ch. 1 properties)

Input parameters

Unit system: SI

Parameter	Value	Unit
Room sensible load	35.000	kW
Room latent load	8.0000	kW
Room dry bulb	24.000	°C
Room relative humidity	50.000	%
Supply dry bulb	13.000	°C
Barometric pressure (absolute)	101.33	kPa

Calculated results

Parameter	Value	Unit
Dry-air mass flow	11,214	kg/h
Supply air volume (at the supply state)	9,211.8	m³/h
Supply humidity ratio	8.2911	g/kg
Supply relative humidity	88.982	%
Room sensible heat ratio	81.395	%

Formula and method

$$\dot{Q}_s = \dot{m}_{da}(c_{pa} + W_s c_{pv})(T_r - T_s), \quad \dot{Q}_l = \dot{m}_{da}(W_r - W_s)\, h_g(T_r)$$

Variables

$\dot{Q}_s$	Room sensible load	W
$\dot{Q}_l$	Room latent load	W
T_r	Room dry bulb	K
φ_r	Room relative humidity	-
T_s	Supply dry bulb	K
p	Barometric pressure (absolute)	Pa
$\dot{m}_{da}$	Dry-air mass flow	kg/s
$\dot{V}_s$	Supply air volume (at the supply state)	m³/s
W_s	Supply humidity ratio	kg/kg
φ_s	Supply relative humidity	-
SHR	Room sensible heat ratio	-

Method and standards

Energy and moisture balance on the room.

Assumptions and limits

- Steady state, perfect mixing.
- The latent load is converted to moisture with the vapour enthalpy at room temperature, h_g = 2501 + 1.86 t kJ/kg (t in °C). Calculators that use 2501 kJ/kg alone (for example the sensible heat ratio and ADP calculator) give a supply humidity about 1–2 % different; both are common textbook forms.

References

- Moist-air energy and moisture balances (ASHRAE Handbook—Fundamentals ch. 1 properties)

Report details

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Release checks	3 reference cases of this calculator, computed independently, are checked on every release

Results are for engineering estimation. Verify critical designs against the referenced standards and your own data.

This calculator online

https://calc.firecad.com/hvac/loads/supply-air-flow-room-load

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.